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Since the dog days of late summer aren't good for much of anything but reflection, the 111 LOG staff recognized September as the perfect month to comment on the basic concern of this publication—namely, the use of language to create a greater awareness of the F-111.

If used properly, the language at our disposal can serve you, our readers, well. If used improperly, it can only serve to confuse. William Strunk, Jr., and E. B. White put it nicely when they wrote: "Clarity is not the prize in writing, nor is it always the principle mark of a good style. There are occasions when obscurity serves a literary yearning, if not a literary purpose, and there are writers whose mien is more overcast than clear. But since writing is communication, clarity can only be a virtue."

As we have said before, the 111 LOG is written for you, and without you it would not exist. With this in mind, we have put together another issue. We hope that you at least find it full of "virtue."

First on the agenda is "111 Training." Proper training is one of the primary functions of an integrated logistic support program, and this logistic article highlights the three primary areas in which the 111 Customer Training Equipment and Technical Services Section is concerned: Simulators; Mobile Training Sets; and Training, Resident Training Equipment, and Training Parts.

One of our regular features, "Do You Know...?" comes next and presents some interesting facts pertaining to runway grooving, which is currently undergoing experimental testing. The preliminary test results indicate that we may see the grooving of all Air Force runways—a "groovy" deal for everybody.

"Electron Beam Welding of D6ac Steel" follows and focuses attention on a research program which was conducted at the Fort Worth Division. Out of the program came a useful discovery: quality electron beam weldments can be produced in D6ac steel, the material used to fabricate many of the large F-111 structures.

Foreign object damage cannot be considered an unavoidable statistic of jet aircraft operation! The F-111 FOD prevention program—which is similar to past FOD prevention programs at General Dynamics—proves that good results can be obtained. That is the message of the fourth LOG entry.

Last, and least in size, are two regulars—Facts and Figures and 111 Logistic Field Directory.
The application of the principles of logistic support for a complex weapon system, such as the F-111, with its multi-service and multi-nation aspects, presents unique problems. Management of the various functions on a world-wide basis requires the utilization of the most advanced programming techniques to assure the orderly accomplishment of phased objectives. One of these functions is Training.

The 111 Customer Training Equipment and Technical Services Section is responsible for coordinating the development and control of training devices for the F-111 Program including basic planning, identification of program requirements, and program direction and evaluation. This Section also provides monitoring of program activities to assure timely support to the customer in training equipment, aircrew and maintenance training, Air Training Command (ATC) resident school training, and Aerospace Ground Equipment (AGE) training.

The 111 Customer Training Equipment and Technical Services Section functions in three primary areas: Simulators; Mobile Training Sets; and Training, Resident Training Equipment, and Training Parts.

**SIMULATORS**

Mission Simulators and Navigator-Bombardier Simulators are being provided the Strategic Air Command (SAC) and ATC in support of the FB-111A Training Program. An additional quantity of Mission Simulators are also being provided to the Tactical Air Command (TAC) and ATC in support of the F-111A/D/E Training Program.
The FB-111A Nav/Bomb Simulator

Technical assistance provided by the 111 Training Section
THE F-111A MISSION SIMULATOR

These simulators provide training during the take-off, flight, and landing phases. This includes training in cockpit preflight and starting procedures, ground operation procedures, normal and emergency inflight procedures, navigational and instrument flight procedures, penetration, attack and weapons delivery procedures, and post-flight and shutdown procedures. These simulators are authentic replicas of sophisticated systems. They are unique in that all activities of both crewmen can be simulated simultaneously throughout the flight envelope.

All these conditions can be produced on the simulator, as well as complete reproduction of ground terrain on "radar" by means of photographic transparencies. Signals are translated to radar video signals and displayed as radar scope presentations in the cockpit and at the instructors console.

The interrelation of flight controls, radar, navigation, bombing, and automatic pilot are accurately reproduced. Cockpit motion is also realistically effected by a three-axis, five-degree-freedom of motion system.

FB-111A Aircrew Training will be conducted at Carswell AFB, Texas; while Navigator Training will be held at Mather AFB, California.

F-111A/D/E Aircrew Training will be held at Nellis AFB, Nevada or Cannon AFB, New Mexico, while Navigator Training will be conducted at Mather AFB, California.

The Simulator Group conducts program planning, disseminates program guidance for the F-111 Simulator Program, and assures adequate planning and procedures for logistic support of the Simulator Program. The Simulator Group also participates in development and update of F-111 Simulator Program Management networks (PERT networks), analyzes the Simulator Program progress, identifies problem areas, prepares program status reports and maintains surveillance of logistic support simulator operations.

The group maintains status and expedites delivery of General Dynamics parts and data to support manufacture of F-111 Simulators as well as to maintain ECP and TCTO status of F-111 Simulators. Coordination with other Logistic Support Department sections is maintained to ensure necessary simulator support in the areas of AGE, spares, and technical publications.

MOBILE TRAINING SETS

A Mobile Training Set consists of all major systems, both mechanical and avionic, that are installed on the F-111 aircraft. Each system is separated and installed on one of approximately forty individual Trainer Panels. The Panels or Trainers are designed to aid and support Air Force instructor personnel in the instruction, theory of operation, location, recognition, servicing, adjusting, troubleshooting, maintenance, inspection, and aircrew operation of the applicable systems of the F-111 Weapon System.

A Mobile Training Set provides the Air Training Command the capability to teach Tactical and Strategic Air Command personnel, in a classroom environment, the techniques and procedures.
NOTE:
The title of each Trainer coincides with the Air Force Speciality Code of the personnel who maintain the related aircraft system. This Trainer and the others shown comprise only a partial Mobile Training Set.

THE UTILITY HYDRAULIC SYSTEM TRAINER

This organizational maintenance trainer consists of two panels. Panels 1 and 2 depict actual nose and main landing gear operations, such as extension, retraction, anti-skid, nose gear steering, warning lights, etc.
THE ARMAMENT SYSTEM TRAINER

THIS ORGANIZATIONAL MAINTENANCE TRAINER consists of three panels. Panel 1 is a simulated weapons bay. Panel 2 consists of one fixed and one pivoting pylon. Panel 3 contains all the crew station controls and indicators associated with the Armament System. Panel 3 alone can simulate all weapons delivery modes, sequencing, and drops. However, the three panels may all be electrically interconnected, which enables all functions of bomb dropping, missile launching, and gun operation (up to actual release and firing) to be accomplished from Panel 3. The Armament System Trainer can be used to teach loading procedures for all stores applicable to the F-111A aircraft.
THE WEAPONS CONTROL SYSTEM TRAINER

PANEL 1

THIS ORGANIZATIONAL MAINTENANCE TRAINER consists of two panels. Panel 1 consists of the Attack Radar Antenna, Antenna Control Unit, Modulator - Receiver - Transmitter, Synchronizer, and other line replaceable units (LRUs). Panel 2 contains all the crew station controls and indicators associated with the Weapons Control System, plus other forward equipment bay LRUs. The Trainer can either emit RF radiation for actual target acquisition, or simulate radar returns using the Function Generator of Panel 2.

PANEL 2

necessary to perform maintenance on the F-111 aircraft. A Mobile Trainer allows the student to have access to the aircraft equipment prior to actual assignment to the flight line or maintenance shops. In a classroom, the student can observe all the equipment of his particular system specialty mounted on a single trainer. This would not be possible if the maintenance training was attempted on an actual F-111. The controls and indicators would be in the aircraft crew module with the operating components installed in various locations throughout the aircraft.

The Trainers are designed to be moved from one location to another as the name mobile implies. As the Air Force completes the training of maintenance personnel at one station, the Trainers are shipped by land, sea, or air to the next station that
requires maintenance training. The Trainers are designed to include permanent shipping containers that can be installed on all panels in just a few minutes. A Mobile Training Set was recently delivered by airlift to Australia for Royal Australian Air Force utilization in training maintenance personnel for the F-111C aircraft.

The 111 Customer Training Equipment and Technical Services Section is responsible for the management of Mobile Training Sets that are manufactured for each version of the F-111 aircraft. The Mobile Training Set Group coordinates the efforts of all Fort Worth Division departments that are affected in the conception, design, manufacture, and delivery of all Trainers. This section of Logistics has been established as the contact point for support of all Mobile Training Sets that have been delivered, being manufactured, or planned for the future.

The success of the F-111 Weapon System in accomplishing its mission is dependent upon the optimum performance of many men and machines. The Mobile Training Set provides one tool for reaching that performance.
THE MAIN LANDING GEAR TRAINER

This intermediate maintenance trainer is one of those being built by the Air Force at Sheppard AFB from parts sent by General Dynamics.

THE ARMAMENT SYSTEM—WEAPON LOADING TRAINER

This intermediate maintenance trainer is located at Lowry AFB where it is being constructed by Air Force personnel from parts sent to it. Air Force weapons loading personnel will begin using this trainer next month, and its expected utilization is 250 hours per month.

TRAINING AND RESIDENT TRAINING EQUIPMENT

Customer Training, In-plant Training, and Vendor Training courses are being provided. This includes the responsibility for coordinating, planning, scheduling of training courses and developing training material, training aids, and manuals.

Resident Training Equipment is being provided to Lowry AFB, Chanute AFB, Sheppard AFB, Keesler AFB, and Lackland AFB, all of which are prime Air Force training centers. The Training and Resident Training Equipment Group’s responsibility is that of recommending, initiating procurement, monitoring status, obtaining costs, and obtaining schedules for training parts consisting of aircraft items as well as AGE items. These parts are used by the Air Force as training aids and/or to fabricate Trainers for use in Air Force Training Programs.

It has been said often that most learning takes place by doing; in other words, actual experience is the best teacher. The men, whose responsibility will be to operate and maintain the F-111, cannot do so efficiently with the end article and technical publications alone. They also need the simulators, mobile training sets, and training equipment and parts necessary for them to “learn-by-doing.” The 111 Customer Training Equipment and Technical Services Section plays a vital role in providing these educational tools.
that our current braking systems, tire tread designs, and runway surface materials are not always able to cope with wet runways? Under tire hydroplaning conditions, hazardous situations can develop. Erecting barriers or lengthening runways, even where possible, is not the answer because most hydroplaning incidents result in the aircraft leaving the runway before it reaches the end.

Currently NASA, the FAA, the Air Force, and some foreign governments are participating in both separate and joint runway grooving experiments aimed at finding both the good and bad effects of runway grooving on aircraft tires and runways. Runway grooving refers to small slots or grooves cut across a runway to improve tire traction and to facilitate water drainage. It is still in the experimental stage, but the preliminary tests promise great potential.

A number of different tests are being conducted under varying conditions. One of these tests, the freeze-thaw cycle, has been completed by NASA. The procedure was to flood the test section of a runway, allow it to freeze overnight, and then run braking tests under ice-covered and water-flooded conditions. They used an aircraft tire run over grooves 1/8 inch wide by 1/8 inch deep, and also over grooves 1/4 by 1/4 inch. After 22 freeze-thaw cycles, there was no decrease in friction from the initial values, nor was there any deterioration in the grooved portion of the runway.

One of the problems is to determine the best size, shape, and angle for the grooves. Some 18 different groove patterns were tried and tested under damp and flooded conditions, over a speed range 4 to 100 knots. Three groove spacings were tried: one inch, one and a half inches, and two inches. Groove widths were 1/8, 1/4, and 3/8 inch. Two depths were studied: 1/8 and 1/4 inch. Three different size aircraft tires were used in both yawed rolling and braking runs. The greatest traction resulted using grooves 1/4 inch wide and 1/4 inch deep on a one-inch pitch. (All the groove arrangements increased the traction.) Preliminary results indicate the following:

1. There was no increase in tire rolling resistance on a grooved runway versus an ungrooved one.
2. There was no increase in tire damage under yawed rolling conditions.
3. There was no damage to tires during braking (even while skidding). However, if the wheel is locked, chevron-type cuts can occur. This type of cutting is not likely with anti-skid equipped aircraft, since the friction coefficients on grooved runways are so high. For example, using a smooth tire, the skidding coefficient ranged from 0.5 to 0.4 on the flooded grooved runway. The same tire developed only a 0.04 skidding coefficient on a flooded ungrooved concrete runway at the same speed.

A program is under development to study the effect of grooving on tire wear. The tests will include running a new aircraft tire through a series of free roll, yawed rolling and braking maneuvers on a grooved runway. The tests will then be repeated with an identical tire on an ungrooved pavement and the results compared.

Other tests are being designed with various objectives. One of these will study takeoff and landing performance on grooved runways. This program will determine the effectiveness of grooving in increasing performance on dry, wet, water-flooded and slush-covered runways having different surface textures. It should also discover whether undesirable aircraft vibrations are caused by the grooving, and if so, to find out how much and why. The tests will be conducted with various aircraft loads under varying weather conditions on both asphalt and concrete surfaces. The tests also should determine the fastest, easiest and most economical method of grooving runways, as well as the most efficient groove pattern.

GROOVED RUNWAYS—TODAY

There are several operational grooved runways in use around the country. Washington National Airport’s main runway has been completely grooved. It took 35 days, working between 11 p.m. and 7 a.m., seven days a week, using diamond
saw machines. Each machine cut 13 grooves at 10 to 20 feet per minute, at a cost of approximately $0.09 per square foot. The pattern used was 1/8 inch wide, 1/8 inch deep on a one-inch pitch. Since completion, over 80,000 landings and takeoffs have been made with no deterioration of the grooves. Pilots report improved handling during landings since the runway was grooved.

Taxiways at several civilian fields throughout the country are also yielding information. The groove patterns on one asphalt taxiway have already started to fail through the plastic flow of the asphalt on very hot days. Where wide grooves have been cut (1/4 to 3/8 inch) airport operators report a housekeeping problem because the wide grooves trap stones and small debris.

At Kansas City Municipal Airport the instrument runway was grooved over half its length. There has been no deterioration after 80,000 landings and takeoffs, and pilots are discovering great improvement in wet weather traction. When approaching this runway from the air, pilots report they can tell the areas that are grooved when it's wet. The ungrooved portion is reflective because of the water pooling, while the grooved portion appears dull because of the increased water drainage. From the ground, this is also evident by the amount of water spray the aircraft throw while on the ungrooved portion of the runway versus the grooved.

At Kennedy Airport, where the main instrument runway is also grooved, tower operators report that since grooving, most jet aircraft now use the high-speed taxiway to clear the runway rather than going to the end. Pilots verified stopping distances have been reduced by about 1,000 feet when the pavement is wet. Prior to grooving, the wet landing performance was not that good. The grooves at Kennedy Airport are clear of rubber deposits after more than 13 months, although the lands between the grooves have been coated with molten rubber from dry touchdowns. They have also withstood the full range of weather conditions offered by the east coast with no ill effects.

Two highly used Air Force runways, Don Muang, Ubon, and Udorn, Thailand, have also been grooved. Results so far indicate improved wet weather performance with skidding incidents greatly reduced. The only incident to date occurred during a rainstorm when an aircraft touched down to the right of the centerline and missed the grooved portion of the runway (a 37-foot wide section). The pilot reported no braking action and slid off the right side of the runway some 2,000 feet after touchdown. This mishap indicates the entire width of a given runway should be grooved.

CONCLUSION

Everyone concerned has been generally pleased with the results of runway grooving, and they agree it will be another aid to safer operations. Airport and aircraft operators, as well as maintenance personnel, have no major complaints so far. There was some concern among the airline operators about possible tire cutting caused by the grooves. A major aircraft tire recapping company reports that only one percent of their current business is due to the chevron-type cuts. They further say these chevron cuts have occurred on aircraft tires for years (before grooved runways) and were attributed to brake chatter.

There have been complaints by pilots about dust clouds thrown up by tire passage over grooves while the runways were in the process of being grooved. This appears to be a problem associated with finishing the job, and should not occur if the dust is washed from the grooves at the time of grooving.

In summary, test results are expected to provide a means for evaluating the effects, both good and bad, of runway grooving. When all the figures are in, we may see the grooving of all Air Force runways—a good deal for all of us.
ELECTRON BEAM WELDING of D6AC STEEL

Several major structural components of the F-111 are D6ac steel weldments. This steel was selected for general use on the airplane because it is an established commercial alloy that is readily fabricated and that has excellent mechanical properties. The weldability and heat-treat characteristics of D6ac make it particularly suitable for the fabrication of large structures.

These components are presently being gas tungsten-arc welded. Due to the complex shape of the weldments, a hot-box is used to maintain the required 350 to 500°F preheat. Several passes are required to complete the welds.

The shorter thermal cycle and reduced weld distortion associated with the electron beam welding process would facilitate production of D6ac weldments. The following program was conducted to determine if aircraft quality weldments could be produced by this process in a single pass without the use of a preheat.

DEVELOPMENTAL EFFORTS

The parameters for electron beam welding are beam current and voltage, welding speed, focus coil current, and gun height. These variables were studied by examining cross sections of typical welds.

Nondestructive inspection and metallographic examination revealed that the geometry of the weld was the best criterion for evaluating the parameters. A weld with parallel sides (Figure 1) is optimum. This is indicative of uniform solidification and cooling.

The geometry of the weld is a function of the energy and focus of the electron beam. The
optimum weld geometry is attained by using the highest beam energy that does not undercut the bottom and leaves only a slight depression on the top of the weld. At this energy level, the required voltage and welding speed vary according to material thicknesses. The best welding speed for D6ac is in the range of 25 to 35 inches per minute. The optimum focal point is at the center-width of the workpiece.

PRELIMINARY EVALUATION

A mechanical property evaluation was conducted on electron beam weldments having the optimum weld geometry. Test results indicated that the joint efficiency, ductility, fracture toughness, and stress-corrosion resistance were comparable to those of the base material. However, the fatigue life was inadequate for anticipated applications.

To determine the cause of poor fatigue life, metallurgical tests were conducted on the failed fatigue specimens. Examination of the fracture surfaces revealed that most of the failures originated at notched voids near the centerline of the fusion zone. The nature of these voids is shown in Figure 2. Apparently, their incidence near the centerline of the fusion zone is related to the directional solidification that characterized these welds. The notched voids did not influence the tensile, fracture toughness, or stress-corrosion properties because of their orientation. They did have a profound effect on the fatigue life: the notch effect created origin sites for premature failures.

In order to reduce the directionality of solidification, an oscillated electron beam was used to prepare sample welds. These samples were evaluated by the geometry criterion described previously. The macrostructure (Figure 1) revealed that beam oscillation broadens the weld zone and disrupts the solidification pattern associated with fixed beam welds.

PROCESS EVALUATION

A complete evaluation was conducted on 1/2-inch-thick plates that were welded with an oscillated electron beam. Each test plate was inspected by magnetic particle, X-ray and ultrasonic methods. Tensile, fatigue, fracture toughness, and stress-corrosion properties were determined for the 220 to 240 and 260 to 280 ksi heat-treat levels.

The results of the tests indicated that the electron beam welds and the base metal had comparable properties. All of the tensile specimens had joint efficiency values in excess of 98 percent. As shown in Figures 3 and 4, the fatigue properties obtained by electron beam welding were superior to those obtained by gas tungsten-arc welding. The fracture toughness and stress-corrosion resistance compared favorably with the base material properties.

CONCLUSIONS

A method has been developed to produce aircraft quality electron beam welds in D6ac steel.

Figure 2
500 X MAGNIFICATION NOTCHED VOIDS characteristic of fixed beam welds.
plate. The key features of this process are the following:

1. No preheat is required.
2. Welding is completed in a single pass.
3. The use of a beam oscillator is necessary for adequate fatigue strength.
4. The mechanical properties of the electron beam welds in the 220 to 240 and 260 to 280 ksi heat-treat conditions are comparable to those of corresponding gas tungsten-arc welds.
ODE TO FOD

or
don't
feed
the
engines

The mighty jet when fed on air
With JP fuel has push to spare;
His gullet withstands terrific heat
Also, insects, ozone and sleet;
For still more zip add H2O
His molars won't strip on the correct ratio;
When dirt or lime drops thrust at last
We clean his teeth with carbon blast.

A very soft diet is essential you see,
For the bane of his life is FOD,
Pencils and caps he cannot take
They really give him a great big ache;
And harder objects like tools and stones
Result in broken teeth and painful groans;
Likewise trash, bolts, washers, and wire
Surely cause his breathing to tire.

Since FOD is the jet enemy we know
And causes so much maintenance woe,
Please watch the jet diet with a careful eye;
For as with rocks in the beans or pits in the pie
The FOD rate is just too high.
If this sounds flippant, it wasn't meant to be. If every individual was as FOD conscious as the unknown SAAMA FOD Project Engineer who penned the above poem, the success of FOD prevention programs, both contractor and military, would be virtually assured. The trouble is, however, every individual is not so FOD conscious. We still have problems in spite of the countless programs designed to prevent the needless waste of money, manhours, and costly parts depletion resulting from FOD.

Here is some recent evidence. An object of undetermined origin wrought havoc during a ground trim run. Numerous fan blades had FOD, and the N-1 rotor was found to be damaged after the engine shop removed the last three stages.

We could go on and on relating reports of recent foreign object damage to jet engines. The fact...
remains, this instance and others could have been prevented. Engine damage from foreign object ingestion is not like death and taxes. It is not inevitable. Something can be done about it. Studies of the causes of foreign object damage invariably show that the majority of them could have been avoided if stronger emphasis had been placed on training, inspection, and supervision. Day by day, the skill of our people and the combat strength of the Air Force are being wasted in what always seems to be, in retrospect, careless or forgetful acts.

Each time an engine is cut down by FOD, somebody picks up an unnecessary tab. The extra costs include the expense of repairing the engine and replacing the damaged parts. There are additional transportation and handling charges if the engine must be returned to the vendor from the contractor or to the depot for overhaul. Procurement costs are increased in buying additional engines and spare parts to replace FOD-failed components. From the contractor to squadron to Headquarters USAF, additional money must be spent for maintenance, supply, and administration. Other projects must often be cut back to replace the funds that literally have been thrown away.

The prime objective of any foreign object damage control program is really very simple. Keep all foreign objects away from any area where they stand a chance of being ingested into an engine or otherwise being deposited so as to interfere with the normal operation of the aircraft. But to
accomplish this objective requires determination, leadership, and close cooperation—both within contractor and Air Force organizations.

Operating on the simplicity theory, one base commander devised an effective method of controlling one phase of foreign object damage. At least once a week he would patrol his flight line carrying a bag. In the bag he would collect the nuts, bolts, pieces of safety wire, stray tools, gloves, bits of uniforms, and tire remnants; all the miscellaneous debris that is found strewn along the taxiways, runways, and hangar areas. Then he would return to his office and send out a call for the FOD control officer.

The exhibits and interviews were encouraging, to say the least. In no time at all, the younger officers got the message. The base commander was also the maintenance squadron commander, and he soon had enrolled approximately 400 assistants in wholeheated support of the program. Due to that kind of support, the number of foreign objects on the flight line declined to the point where the commander was hard put to find even a discarded cotter pin.
In an effort to improve upon the FOD prevention efforts of the General Dynamics Fort Worth facility, the above case history and others, as well as the FOD prevention programs of other companies were reviewed for their salient points. The result has been an F-111 FOD program which has significantly decreased incidences of foreign object damage since its inception early in 1967.

Prior to this, management realized that the FOD rate was increasing from the normal. They further concluded that the so-called "normal" rate was unnecessarily high, and in the interests of economy, safety, and readiness, could not be tolerated. Management knew that the causes of foreign object damage of all types could generally be placed in three categories: (1) poor housekeeping, (2) poor maintenance practices, and (3) carelessness. In the formulation of the F-111 FOD prevention program at General Dynamics, the above categories were given prime consideration by a FOD prevention team consisting of representatives of all affected departments. A FOD Prevention Administrator was assigned to head the team, and the implementation of the Foreign Object Damage Prevention Program was made his direct responsibility.

The task was mainly one of education and motivation. Problem areas were coordinated between 111 Field Operations and factory areas. Thought provoking, eye catching posters were displayed in work areas. All affected personnel, up through supervision, were (and still are) shown military service films on foreign object damage such as "Foreign Object Damage," "The Case of the Missing Pliers," and the Navy film "The Big Payoff." FOD reminders such as disposal units for hardware, foreign object containers, and posters for run stations and flight line service vehicles were designed and fabricated.

Responsibilities were designated to personnel at various levels to monitor and enforce the FOD prevention procedures set forth by management. For example, field and service mechanics were made responsible for observing the areas around aircraft, serving as constant reminders to fellow workmen to pick up foreign objects on sight and keep their working areas clean. Each FOD Team member was given the responsibility of observing aircraft areas for cleanliness, assuring that all personnel empty their shirt pockets prior to going on top of or entering aircraft, and encouraging and instructing all personnel to prevent FOD.

THOUGHT-PROVOKING AND EYE-CATCHING EXHIBITS displayed in all work areas help to educate personnel in the perils of FOD.
Foreign object inspection procedures were outlined for use prior to initial engine runs, daily engine runs, engine replacement, after taxi, and after first flight.

The F-111 FOD Prevention Program, through intense education, strict controls, and close cooperation between Field Operations, Engineering, and various factory areas has produced results. During 1966, there were eight engines damaged due to unknown foreign objects. From January 1967 through August 26, 1967, seven engines were damaged due to unknown foreign objects. From that point, there were no incidents until February 19, 1968, when one engine was damaged. Since then, there have been only two instances of engine damage due to unknown foreign objects. However, even two are still two too many.

As we have said before, FOD of any type is not inevitable. It can be prevented. Some may say we are being unrealistic, but we don't think so. The wholehearted support of all of us in furthering the education and motivation of those associated with aircraft will make prevention of FOD a reality.

### FACTS AND FIGURES AS OF 30 JULY 1968

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EDWARDS AIR FORCE BASE: (Category I)

V. L. Allwardt
Address: General Dynamics, Fort Worth Division
P.O. Box 428
Edwards, California 93523
Phone: 1-805-277-3745

EDWARDS AIR FORCE BASE: (Navy BTP)

John Norris
Address: Grumman Aircraft Engineering Corp.
P.O. Box 446
Edwards, California 93523
Phone: 1-805-27/73556

EDWARDS AIR FORCE BASE: (Category II)

R. Schaper
Address: General Dynamics, Fort Worth Division
P.O. Box 428
Edwards, California 93523
Phone: 1-805-27/73549

EDWARDS AIR FORCE BASE: (NASA)

W. J. Belliston, Room 1058
Address: General Dynamics Tech. Rep.
NASA FRC
P.O. Box 273, Building 4801
Edwards, California 93523
Phone: 1-805-258-3311 Ext. 234

EGLIN AIR FORCE BASE:

C. C. Widamam
Address: General Dynamics, Fort Worth Division
P.O. Box 1815
Eglin Air Force Base, Florida 32542
Phone: 1-904-882-2761/3566

HUGHES AIRCRAFT COMPANY:

Peter Layton
Address: Grumman Office
M 71 M 194
Culver City, California 90232
Phone: 1-213-391-0711 Ext. 7868

LANGLEY AIR FORCE BASE:

E. L. Patrick
Address: Headquarters TAC (DMMF1)
Langley Air Force Base, Virginia 23365
Phone: 1-703-764-4009 or 5136

LOWRY AIR FORCE BASE:

R. D. McGrady
Address: General Dynamics, Fort Worth Division
P.O. Box 31247
Hoffman Heights Branch
Aurora, Colorado 80010
Phone: 1-303-394-3569

MC CLELLAN AIR FORCE BASE:

R. J. Helm
Address: P.O. Box 214817
Sacramento, California 95821
Phone: 1-916-643 Ext. 6860/5066

TAKHLI RTAFB (Det. 1 428TFS)

Address: General Dynamics Corporation
P.O. Box 3415 CMR
APO San Francisco, California 96273
Attn: W. J. Johnson

NELLIS AIR FORCE BASE: (474th TFW)

J. K. Johnson
Address: General Dynamics, Fort Worth Division
P.O. Box 9711
Nellis Air Force Base, Nevada 89110
Phone: 1-702-643 Ext. 2243/2383/4755

OFFUTT AIR FORCE BASE:

V. L. Patterson
Address: General Dynamics, Fort Worth Division
P.O. Box 13252
Offutt Air Force Base
Omaha, Nebraska 68113
Phone: 1-402-294-5001

WARNER-ROBINS AIR FORCE BASE: (WRNTTC)

A. L. Wilson
Address: General Dynamics Tech. Rep.
P.O. Drawer AD
Warner-Robins, Georgia 31093
Phone: 1-912-926 Ext. 6008